## What is claimed is:

[Claim 1] A cloud point monitoring device for installation in a fuel flow system of a vehicle, for determining formation of wax crystals in diesel fuel in the vehicle, comprising:

a thermal conductive surface;

a thermal device to change thermal conditions of said thermal conductive surface;

a detection volume in close proximity to said thermal conductive surface, said detection volume being open to the fuel flow system of the vehicle to allow fuel to flow through said detection volume;

a temperature sensor to sense temperature of the diesel fuel in said detection volume;

a light source which produces and directs light into said detection volume;

a light detector to detect a change in light level from said light source in said detection volume, said change in light level being relative to the positioning of said light source in relation to said light detector; and

a data acquisition and control unit to monitor light level from said light detector and monitor diesel fuel temperature from said temperature sensor.

[Claim 2] The cloud point monitoring device of claim 1, wherein said detection volume is an open area embedded inside said thermal conductive surface.

[Claim 3] The cloud point monitoring device of claim 2, wherein said thermal conductive surface includes a channel within said thermal conductive surface to direct the light from said light source into said embedded detection volume and wherein said thermal conductive surface includes a channel within said thermal conductive surface to said light detector in order to detect the change in light level from said light source that has be directed into said embedded detection volume.

[Claim 4] The cloud point monitoring device of claim 3, wherein a fiber optic cable directs the light from said light source into said detection volume along said channel and wherein a fiber optic cable detects the change in light from said light source that has been directed into said embedded detection volume and transmits the light to said light detector along said channel.

[Claim 5] The cloud point monitoring device of claim 2, wherein said detection volume includes a reflective side surface to enhance scattering of the light towards said light detector.

[Claim 6] The cloud point monitoring device of claim 5, wherein said light source is directed towards said reflective side surface, so that the light is directed towards said reflective side surface.

[Claim 7] The cloud point monitoring device of claim 2, wherein said thermal device is embedded in said thermal conductive surface.

[Claim 8] The cloud point monitoring device of claim 2, wherein said thermal device is a cooler.

[Claim 9]

9. The cloud point monitoring device of claim 8, wherein said cooler is embedded in said thermal conductive surface.

[Claim 10] The cloud point monitoring device of claim 1, wherein said temperature sensor is embedded in said thermal conductive surface.

[Claim 11] The cloud point monitoring device of claim 2, wherein said temperature sensor is embedded in said thermal conductive surface.

[Claim 12] The cloud point monitoring device of claim 1, wherein said detection volume is formed by a detection wall unit above said thermal conductive surface.

[Claim 13] The cloud point monitoring device of claim 12, wherein said detection wall unit emanates from said thermal conductive surface.

[Claim 14] The cloud point monitoring device of claim 12, wherein said light source emanates from said detection wall unit into said detection volume and wherein said light detector includes a light transmitting device in said detection wall unit to detect changes in said light level in said detection volume.

[Claim 15] The cloud point monitoring device of claim 14, wherein said light source includes a fiber optic cable which emanates from said detection wall unit and wherein said light transmitting device is a fiber optic cable.

[Claim 16] The cloud point monitoring device of claim 12, wherein said cloud point monitoring device is positioned between two walls to protect said cloud point monitoring device from random movement of the diesel fuel, yet allow fuel to pass through said cloud point monitoring device.

[Claim 17] The cloud point monitoring device of claim 1, wherein said light source is positioned relative to said light detector, such that there is an increase in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals scatters said light towards said light detector.

[Claim 18] The cloud point monitoring device of claim 1, wherein said light source is positioned relative to said light detector, such that there is a decrease in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals blocks said light away from said light detector.

[Claim 19] The cloud point monitoring device of claim 2, wherein said light source is positioned relative to said light detector, such that there is an increase in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals scatters said light towards said light detector.

[Claim 20] The cloud point monitoring device of claim 2, wherein said light source is positioned relative to said light detector, such that there is a decrease in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals blocks said light away from said light detector.

[Claim 21] The cloud point monitoring device of claim 5, wherein said light source is positioned relative to said light detector, such that there is an increase in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals scatters said light towards said light detector.

[Claim 22] The cloud point monitoring device of claim 12, wherein said light source is positioned relative to said light detector, such that there is an increase in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals scatters said light towards said light detector.

[Claim 23] The cloud point monitoring device of claim 12, wherein said light source is positioned relative to said light detector, such that there is a decrease in said light level due to the formation of said wax crystals, whereby the formation of said wax crystals blocks said light away from said light detector.

[Claim 24] The cloud point monitoring device of claim 1, wherein a surface of said thermal conductive surface near said detection volume is reflective to reflect light and enhance the scattering of light towards said light detector.

[Claim 25] The cloud point monitoring device of claim 1, wherein said light source and light detector are mounted very near said thermal conductive surface such that the first wax crystals formed nearest to said thermal conductive surface are detected in said detection volume and wherein said light source and light detector are positioned so that a minimal amount of light from said light source is detected by said light detector when there are no wax crystals in the fuel.

[Claim 26] The cloud point monitoring device of claim 1, wherein said light source and light detector are mounted very near said thermal conductive surface such that crystals formed first nearest to said thermal conductive surface are detected in said detection volume and wherein said light source and light detector are positioned so that all of the light from said light source is detected by said light detector when there are no wax crystals in the fuel.

[Claim 27] A cloud point monitoring device, for determining formation of wax crystals in diesel fuel, comprising:

a thermal conductive surface;

a thermal device to change thermal conditions of said thermal conductive surface;

a detection volume in close proximity to said thermal conductive surface;

a temperature sensor to sense temperature of the diesel fuel in said detection volume;

a light source which directs light into said detection volume;

a light detector to detect a change in light level from said light source in said detection volume, said change in light level being relative to the positioning of said light source in relation to said light detector; and

a data acquisition and control unit to monitor light level from said light detector and monitor diesel fuel temperature from said temperature sensor and

a ramp in said detection volume which leads from an upper surface of said thermal conductive surface down to a bottom of said detection volume.

[Claim 28] A method of monitoring cloud point of diesel fuel, using a cloud point monitoring device which includes a thermal conductive surface, a thermal device to change thermal conditions of the thermal conductive surface, a detection volume in close proximity to the thermal conductive surface, a temperature sensor to sense temperature of the diesel fuel in the

detection volume; a light source which directs light into the detection volume, a light detector to detect a change in light level from the light source in the detection volume, the change in light level being relative to the positioning of the light source in relation to the light detector, and a data acquisition and control unit to monitor light level change from the light detector and monitor diesel fuel temperature from the temperature sensor, comprising:

inputting fuel into the detection volume from a fuel flow system of the vehicle;

directing light from the light source into the detection volume;

detecting the light level at the light detector

monitoring the light level change at the light detector;

sensing and monitoring the temperature of the diesel fuel in the detection volume;

cooling the diesel fuel in detection volume until wax crystals are formed, so that the light level monitored is changed; and

recording temperature of the diesel fuel in the detection volume at a value point where the light level changes, the recorded temperature at the value point where the light level changes being the cloud point of the diesel fuel.

[Claim 29] The method of claim 28, further using a detection volume having an open area embedded inside the thermal conductive surface.

[Claim 30] The method of claim 28, wherein further using a the detection volume is formed by a detection wall unit above the thermal conductive surface.

[Claim 31] The method of claim 28, further including performing the cooling in the detection volume at a rapid pace so that the recorded temperature is a first sensed temperature that is an a recorded approximate of the cloud point and considered in the region of the cloud point of the fuel.

[Claim 32] The method of claim 31, wherein temperature of the recorded approximate of the cloud point is a first temperature point; further warming the diesel fuel slightly above the first temperature point to dissipate the wax crystals formed; further cooling the diesel fuel at a slower rate in the detection volume until wax crystals are formed, so that the light level monitored is changed; and recording a second temperature point where the light level changes at the slower rate, the second temperature being an accurate determination of the cloud point of the diesel fuel.

[Claim 33] The method of claim 28, further including using the data acquisition and control unit to correlate the recorded temperature known as the cloud point with a current temperature of the diesel fuel colder than the cloud point to determine an approximate amount of wax crystal build up in the diesel fuel based on know relationships between wax content and temperature below the cloud point.

[Claim 34] The method of claim 28, further including using the data acquisition and control unit to correlate the recorded temperature known as the determined cloud point of the diesel fuel to approximate energy content of the diesel fuel based on a relationship of energy content of the diesel fuel to cloud point value.

[Claim 35] The cloud point monitoring device of claim 28, wherein the light source and light detector are mounted very near the thermal conductive surface such that the first wax crystals formed nearest to the thermal conductive surface are detected in the detection volume and wherein the light source and light detector are positioned so that a minimal amount of light from the light source is detected by the light detector when there are no wax crystals in the fuel.

[Claim 36] The cloud point monitoring device of claim 28, wherein the light source and light detector are mounted very near the thermal conductive surface such that the first crystals formed first nearest to the thermal conductive surface are detected in the detection volume and wherein the light source and light detector are positioned so that all of the light from the light source is detected by the light detector when there are no wax crystals in the fuel.